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(51) INTCL<sup>4</sup>  
**B63H 19/00**

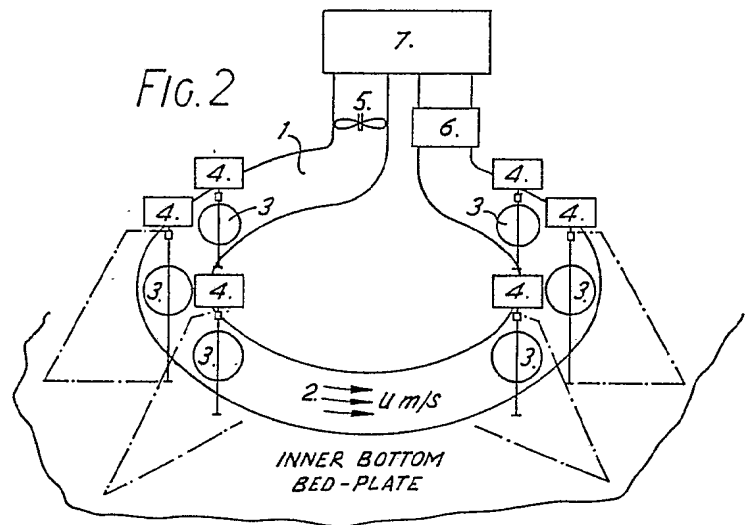
(52) Domestic classification (Edition I):  
**B7V BE**

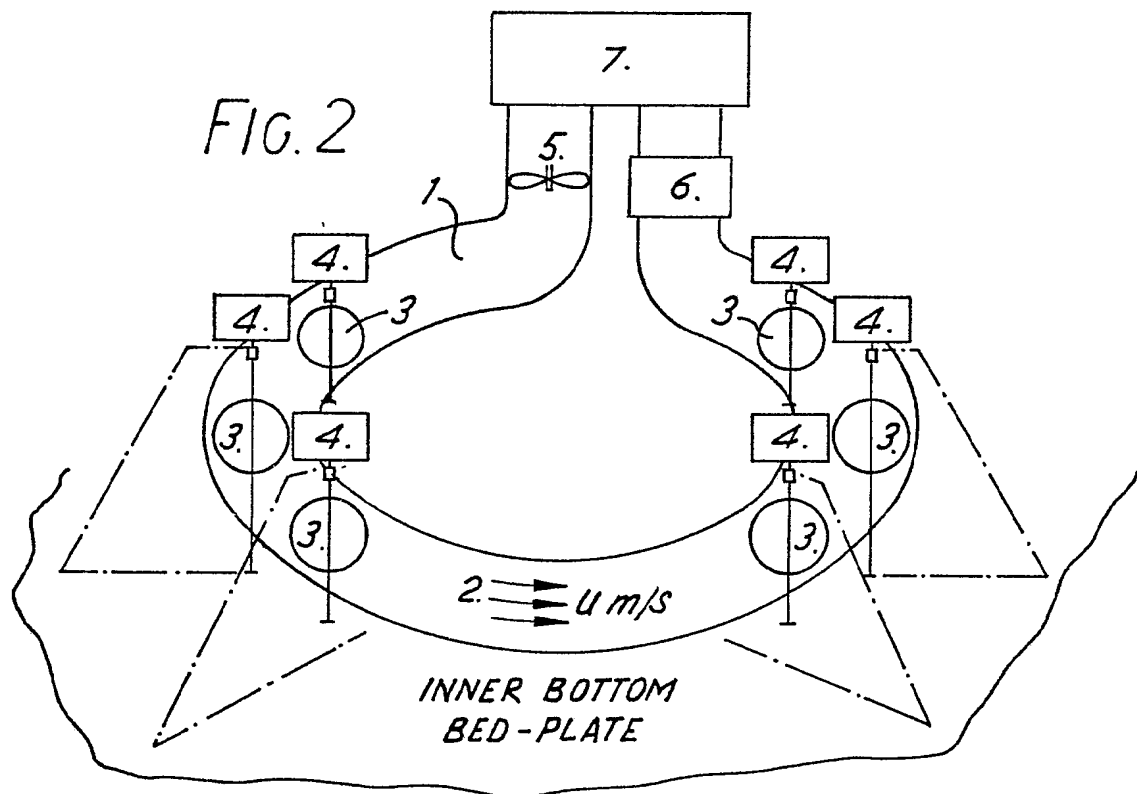
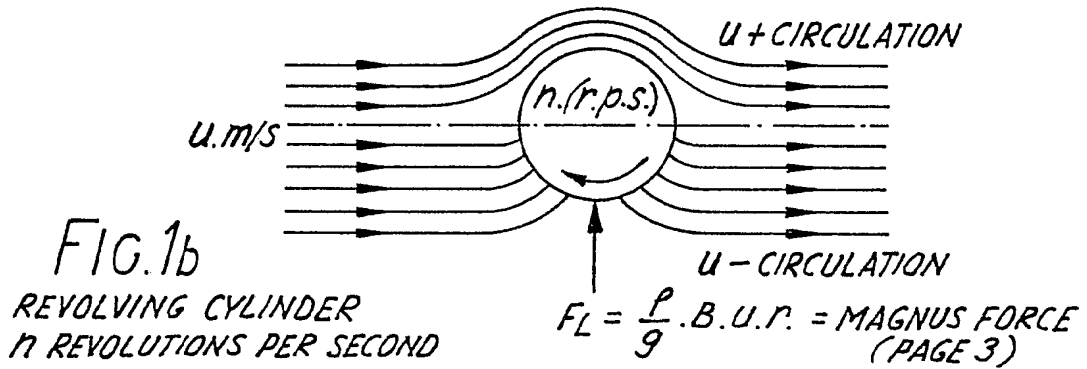
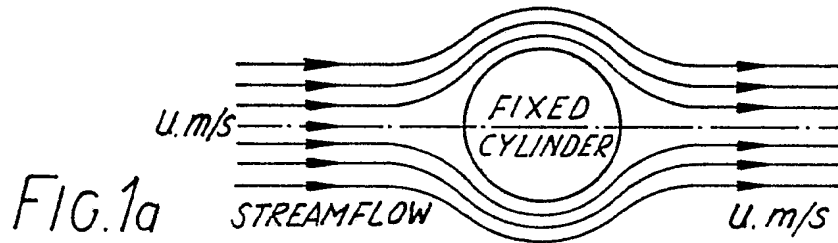
(56) Documents cited  
**None**

(58) Field of search  
**B7V**  
**Selected US specifications from IPC sub-class B63H**

(54) Improvements in propulsion systems

(57) A propulsion apparatus comprises a closed conduit (1), a plurality of magnus effect rotors (3) mounted for rotation therein, means (5) for generating a fluid flow in the conduit (1) and drive means (4) for driving the rotors, whereby a propulsion force is generated acting on the rotors (4) to propel the apparatus.





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CLOSED CYCLE FLUID FORCE MACHINE

FIG.3

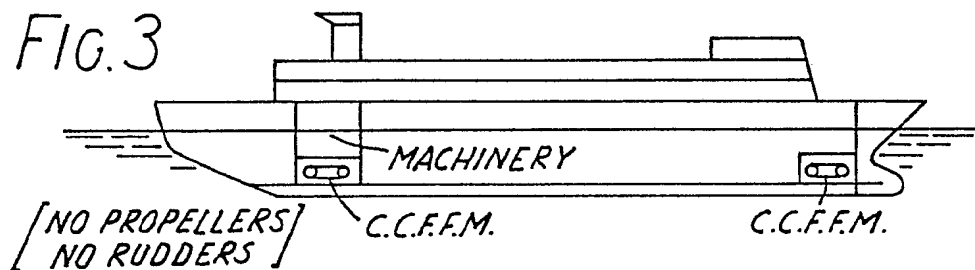


FIG.4

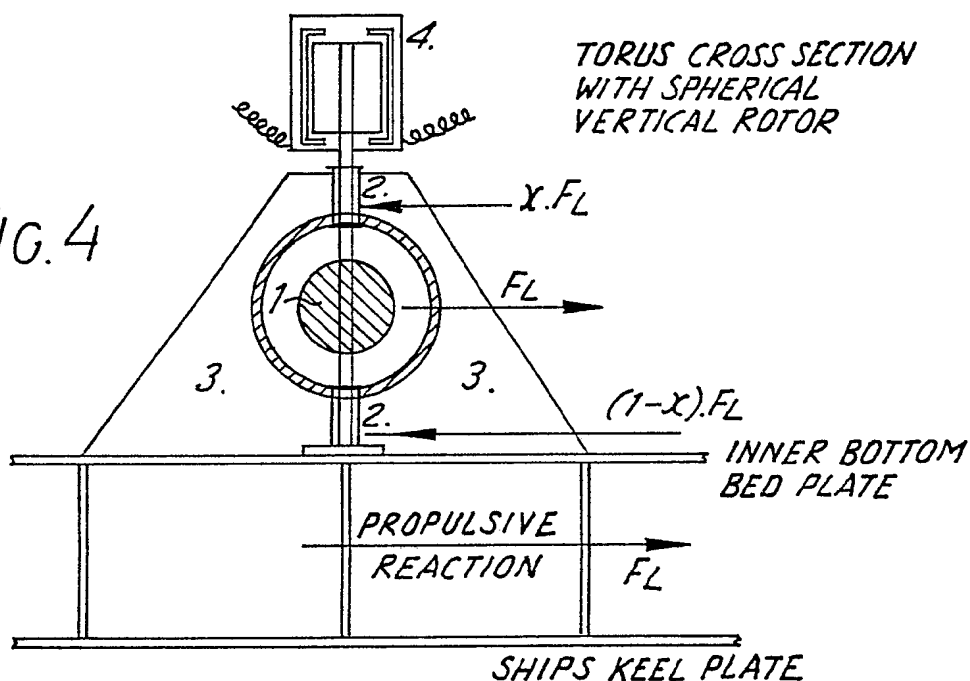


FIG.5a

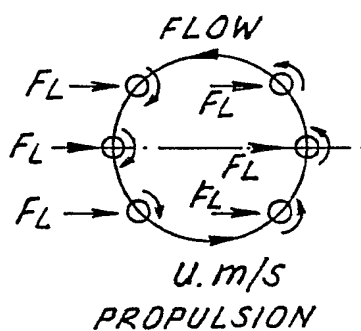
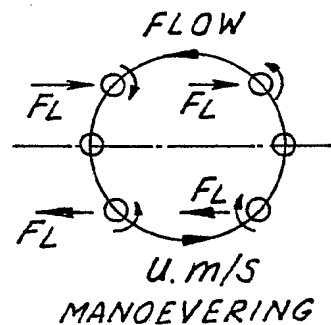
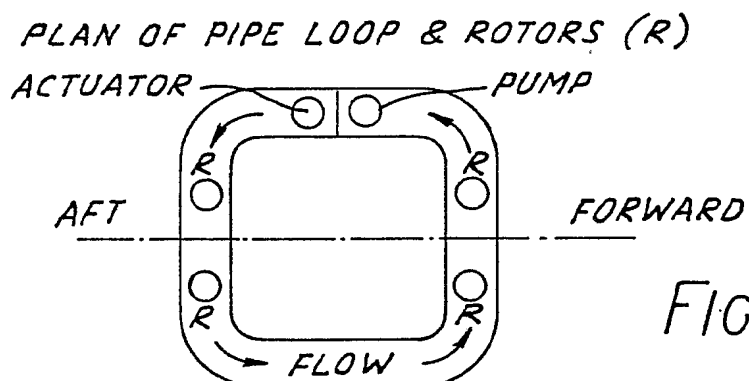
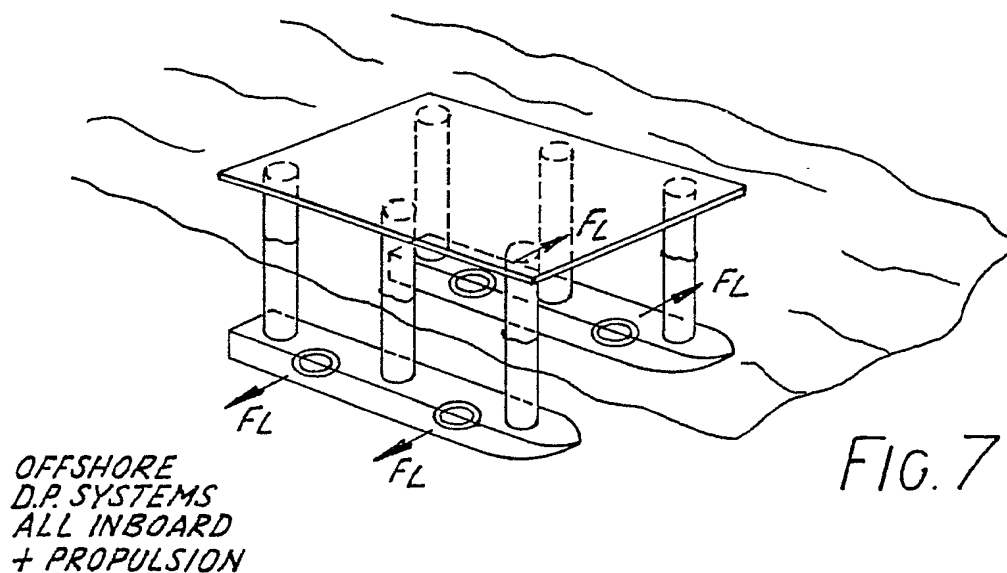
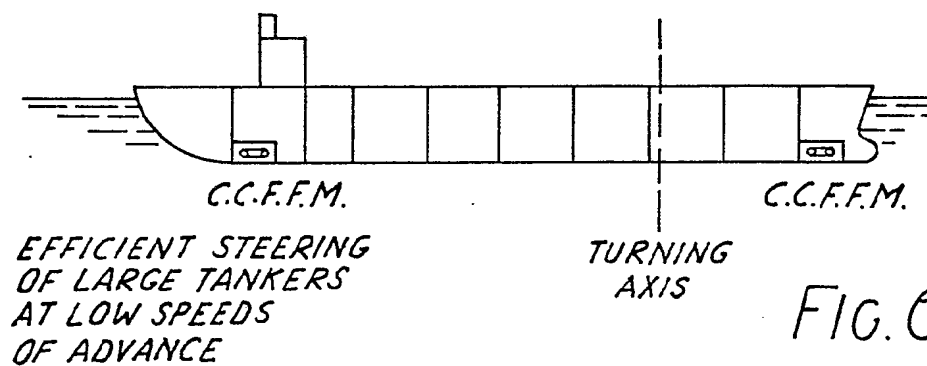


FIG.5b





THE PIPE LOOP CAN HAVE ANY SUITABLE GEOMETRY IN COMBINATION WITH ANY ROTOR CONFIGURATION

## SPECIFICATION

## Improvements in propulsion systems

- 5 This invention concerns the propulsion, manoeuvring, and dynamic positioning of vehicles, more especially 5  
marine vehicles and ships, where water or other heavier fluid will be the driving medium.

The application of the invention, using water, air, or other light fluid will also be possible to aircraft and  
aerospatial vehicles.

The application of the invention using a fluid, will be suitable for land vehicles and for lifting machines.

10 10

*Historical technical background*

The invention is developed from the "Magnus Effect", first observed at Berlin in 1852. An early successful  
application of the Magnus Effect was achieved by Dr. Anton Flettner, in 1925, when his wind propelled  
rotor-ship "BARBARA", made several crossings of the Atlantic Ocean. The "BARBARA", was arranged with  
15 three vertical cylinders (height 17.0 metres, diameter 4.0 metres), located on the weather deck, and rotated by 15  
electric motors, so as to generate a "lift" or propulsive force, within the random air streams, and as a result of the  
Magnus Effect.

At the present time, the marine explorer Jacques Cousteau, in association with the Pechiney Research Centre  
at Voreppe, France, have developed, and successfully tested their research ships with "turbo sails", "MOULIN A  
20 VENT" and "MOULIN A VENT 2", during ocean crossing. It is claimed that this "turbo sail" system produces an 20  
energy saving of about 35%, when used in association with a normal screw-propulsion system. This energy  
saving is in agreement with the 1925 findings of Dr. Flettner.

Both Flettner and the Cousteau-Pechiney wind propulsion systems are based upon the Magnus Effect, and  
both these systems are subject to the vagaries and randomness of the atmospheric wind conditions on the  
25 oceans. 25

*The Magnus effect*

*Figure 1a*, shows a stationary right circular cylinder of radius R metres and length B metres, situated within a  
uniform streamflow having a velocity U metres/second. If the cylinder is perfectly symmetrical, then the uniform  
30 streamflow remains symmetrical about the XX axis, and there is no transverse (pressure), force induced. 30

*Figure 1b*, shows the same right circular cylinder, being rotated at n revolutions per second, within the same  
uniform stream-flow (U.m/s), and it is apparent that a fluid circulation  $\Gamma$  square metres/second, has developed  
within the stream-flow thus increasing the upper streamflow velocity, and with consequent retardation of the  
lower stream flow.

35 Resulting from the velocity redistribution, around the revolving cylinder, there is a redistribution of the 35  
pressures within the streamflow. This generates, the crossflow (pressure) force  $F_L$ , kilograms, which according to  
the KUTTA-JOUKOWSKI theorem, has a magnitude:

$$F_L = \frac{P}{J} \cdot B \cdot U \cdot \Gamma \text{ Kilograms}$$

40 40

where P = Specific Weight of the Fluid Kg/M<sup>3</sup>

J = Acceleration due to gravity = 9.81 M/s<sup>2</sup>

B = Length or Height of cylinder metres

U = Streamflow uniform Velocity M/s

45 = Circulation M<sup>2</sup>/s 45

An object of the invention is to provide a novel propulsion system utilising the Magnus Effect. This object is  
achieved by the features of Claim 1.

A machine according to one example of the invention comprises a horizontal torus, or circle of pipe, to give a  
continuous controlled fast flow (Um/s) of fluid. Located vertically within the pipe torus, and of suitable  
50 dimensions R and B, are a sufficient number of rotating cylinders, (spheres or ovoids), in order to produce a 50  
controlled "Magnus force" which can act as a propulsive, manoeuvring or dynamic positioning force system.  
This magnus force system acts within a closed fluid cycle, thus ensuring constancy and controllability.

By using water as the fluid medium, instead of air, the generated forces  $\Sigma F_L$ , are magnified  $\times 820$  times.

So far as is known, all extant "Magnus Effect" machines have used "open" wind or sea forces, and so far there  
55 have been no "closed" cyclic flow systems. 55

In Germany "Flettner" type rotors are used as a ship steering system in "open" water.

Referring to Figure 2 a torus or closed ring of pipe 1 is manufactured in steel for marine applications, and in  
light metal or plastic material, for land and aerospace applications. The pipe ring may be circular or elliptical or  
of some other suitable cross section, so as to ensure a constant stream flow fluid velocity 2, around the closed  
60 cycle. For marine closed cycle application the fluid would be fresh water or other more suitable heavy fluid, while 60  
for aerospace or land application, the fluid would be air or other heavier gas.

For marine applications to surface ships, the fluid pipe ring units, would be located within the ships hull,  
attached strongly to the ships structure, and with their horizontal planes arranged parallel to the ships keel as  
indicated in Figure 3. It is envisaged that ships would be arranged with one forward propulsion/manoeuvring

65 ring unit, and one after propulsion/manoeuvring ring unit. 65

Within each torus or pipe ring Unit 1, of Figure 2 are located the requisite number of working metal spherical Magnus rotors 3, each powered by uni-controllable electric motors 4, to rotate on their vertical axis, and driven at a suitable speed (n. revolutions per second), each to generate a horizontal force ( $F_L$  kilograms) within the pipe streamflow (U.m/s).

- 5 The constant streamflow velocity (U.m/s), 2, of Figure 2 is obtained by an interdependent system of actuator 5, and pump 6, each in association with a fluid circulation header tank 7, thus completing a closed fluid flow system which can be fully controlled. 5

*Figure 4* illustrates a cross-section, showing one spherical vertical rotor, driven by an electric motor, or air motor, or fluid drive unit, this spherical rotor 1, arranged with pressure-tight bearings 2, which absorb and transmit the generated horizontal force ( $F_L$  kilograms), to the ships structure 3. With any adopted mono-directional streamflow (Um/s), within the torus, the horizontal forces ( $\Sigma.F$  kilograms) are directionally reversed by causing the reverse rotation of the metal spherical vertical rotors 1. 10

Similarly, if the metal spherical rotors, are arranged to revolve about a horizontal axis, within a horizontal closed ring streamflow, then the Magnus reaction will produce a vertical force ( $F_L$  kilogrammes), which has application to aerospace, land-lift, and submarine transport. 15

It is envisaged that for application to large ships, two torus pipe systems, each arranged with six independently driven metal spherical rotors, and located forward and aft, would be required. The direct forward propulsive mode for a six-rotor torus, is indicated in *Figure 5a*, while the manoeuvring mode is indicated in *Figure 5b*.

Fundamental applications of this system, arise in the improved manoeuvring of large tankers, and in the dynamic positioning of off shore units, as indicated in *Figures 6* and *7*, respectively. 20

Finally it is to be emphasized that the closed cycle fluid loop, need not be circular in configuration. This loop could well be a closed rectangle with rounded corners, as in *Figure 8*.

## CLAIMS

- 25 1. A propulsion apparatus comprising a closed fluid conduit, means for generating a fluid flow within said conduit, at least one magnus effect rotor mounted within said conduit for rotation upon an axis and means for rotating said rotor upon its axis whereby in accordance with the fluid flow within said conduit and the speed of rotation of the rotor a propulsion force is caused to act upon the rotor and, via the rotor mounting, the propulsion apparatus. 30
2. An apparatus as claimed in Claim 1, wherein said conduit describes a closed circuit whereby fluid when flowing therein is caused to recirculate past the rotor or rotors.
3. A propulsion apparatus as claimed in Claim 2, wherein a plurality of said rotors are located within said conduit.
- 35 4. A propulsion apparatus as claimed in Claim 3, wherein said rotors are arranged to be driven independently of one another by separate drive means that are individually controllable, whereby by variation of the correspondingly generated thrust forces the direction of a resultant force upon said apparatus can be controlled. 35
5. A propulsion apparatus as claimed in Claim 4, wherein the direction of rotation of at least one of said rotors is reversible.
- 40 6. A propellable vehicle including a propulsion system as claimed in any one of Claims 1 – 5. 40
7. A vehicle as claimed in Claim 6 including two or more relatively spaced propulsion systems as claimed in any one of Claims 2 – 5.
8. A vehicle as claimed in Claim 6 or 7, wherein said vehicle is a surface land or sea vehicle having said propulsion system or systems arranged with the closed fluid circuit aligned in a horizontal plane and the axis or 45 axes of the rotor or rotors in a vertical plane. 45
9. A vehicle as claimed in Claim 6 or 7 wherein the propulsion system or systems comprise a plurality of rotors arranged with their axes horizontal whereby the thrust forces upon the rotors act in a vertical direction.
10. A propulsion system substantially as described herein with reference to any one of Figures 2 – 8 of the accompanying drawings.